United States Patent [19]

Lesher

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[54] **APPARATUS FOR CLOSING AND SEALING A DOORWAY**

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[51] **Int. Cl.**[3] **E05D 15/10**

[52] **U.S. Cl.** ..... **49/225**; 110/173 R

[58] **Field of Search** ..... 49/225, 209, 210, 216, 49/219, 220, 221; 110/173 R, 177

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,059,290	10/1962	Tobin	49/225
3,399,875	9/1968	Ipsen	263/36
3,410,547	11/1968	Bielefeldt	266/5
3,558,112	1/1971	Gaede	263/36
3,583,690	6/1971	Bornor	263/36
4,165,667	8/1979	Brolund et al.	83/409

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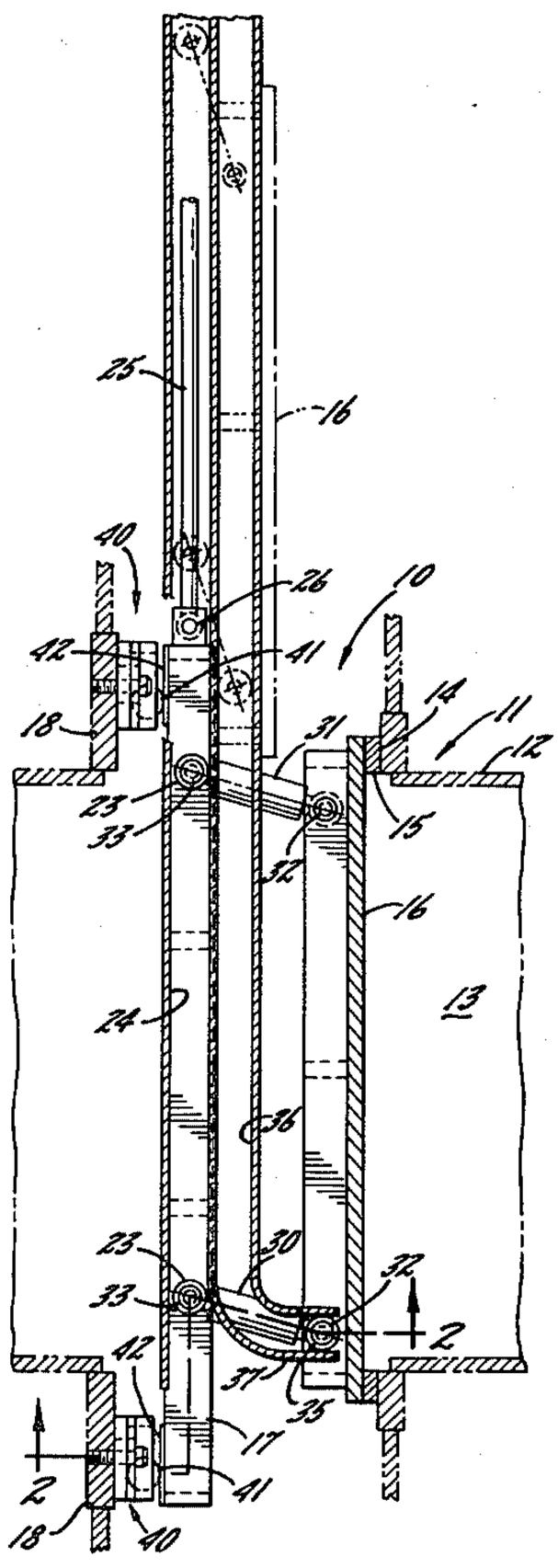
Attorney, Agent, or Firm—Leydig, Voit, Osann, Mayer & Holt, Ltd.

[57] **ABSTRACT**

A door is mounted on a carrier to move back and forth with the carrier between open and closed positions relative to a furnace doorway and to move inwardly relative to the carrier to seal the doorway. Bearing means engage the outer side of the carrier to support the carrier with rolling friction and to sustain the outward thrust which is imposed on the carrier when the door is moved inwardly to seal the doorway. The bearing means comprise a single spherical ball which is captivated in a cage to roll back and forth when the carrier is shifted and, at the same time, to spin universally about its own center.

5 Claims, 5 Drawing Figures



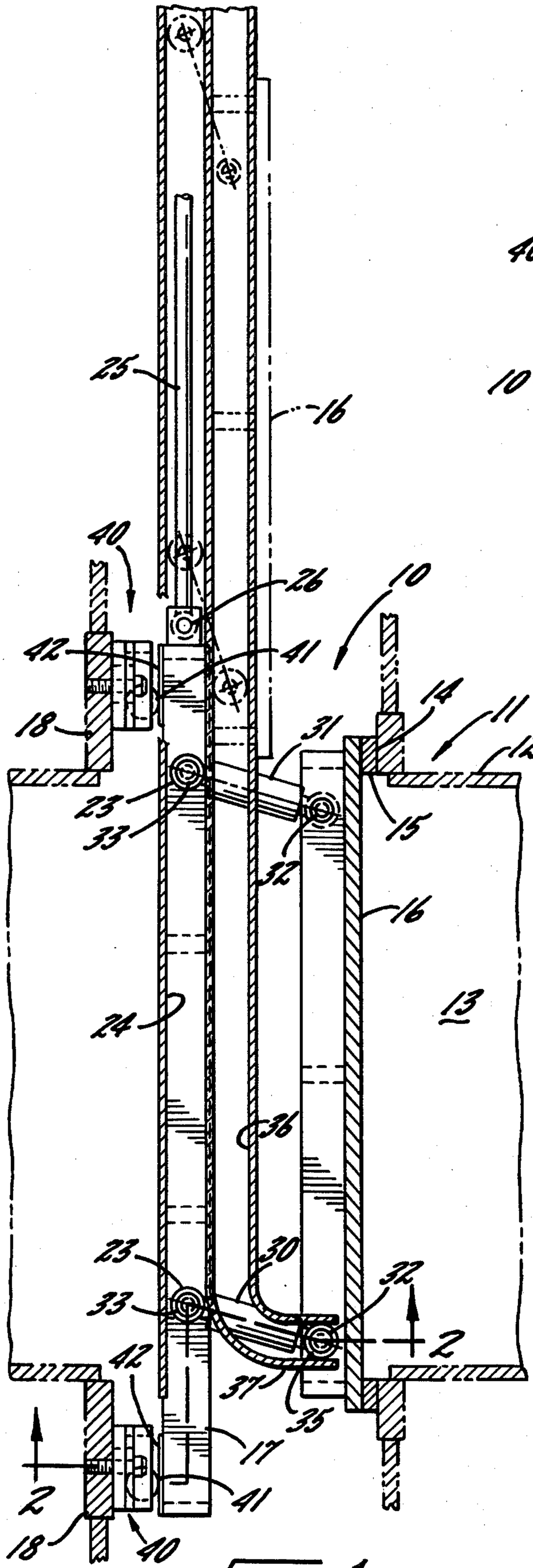

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Fig. 1.

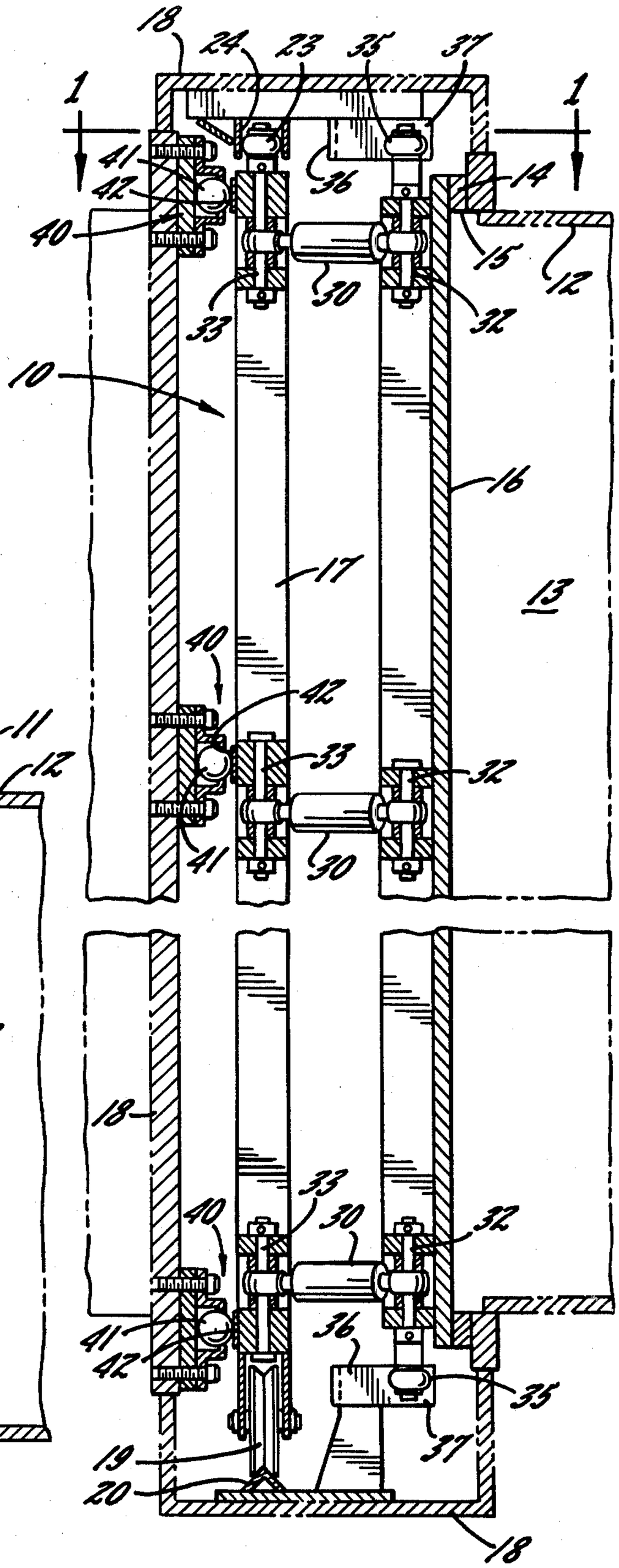
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Fig. 2.

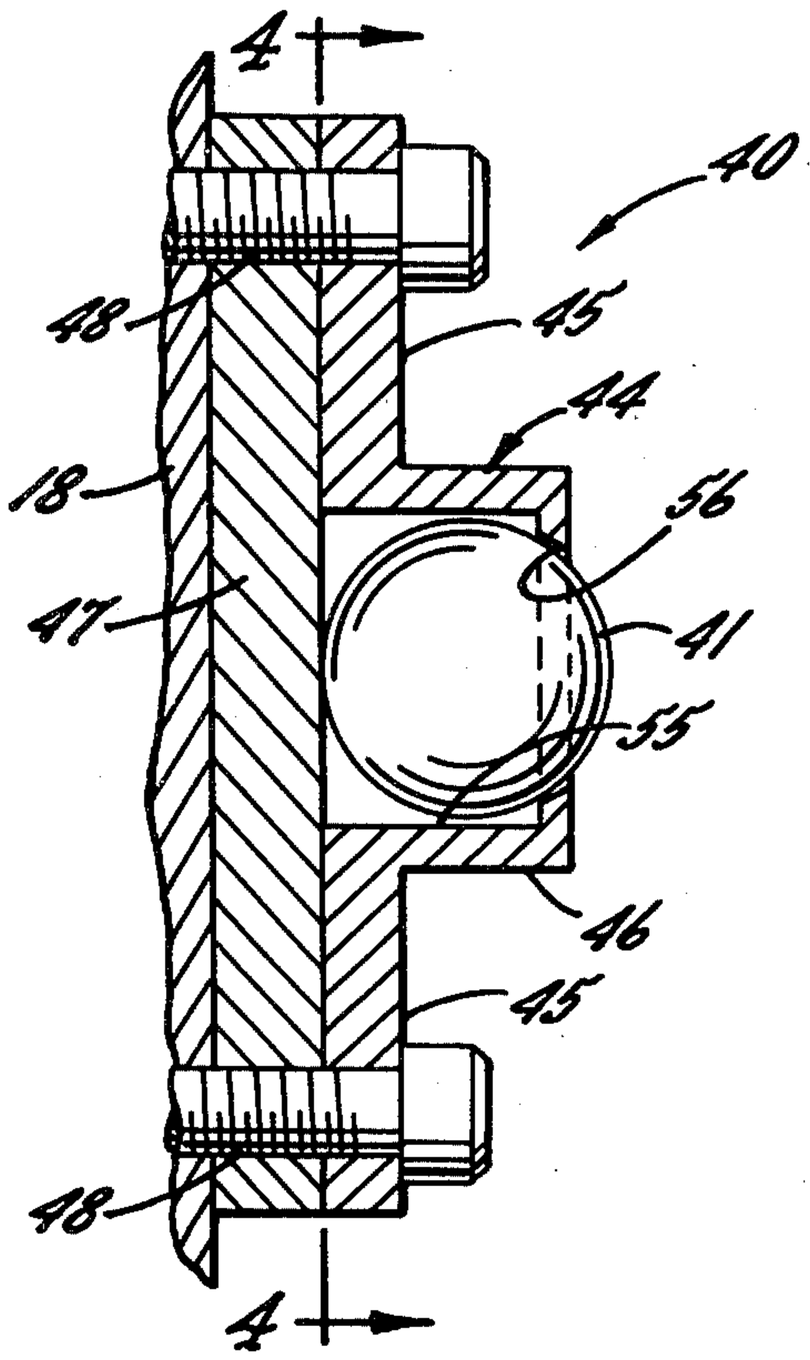

Fig. 3.

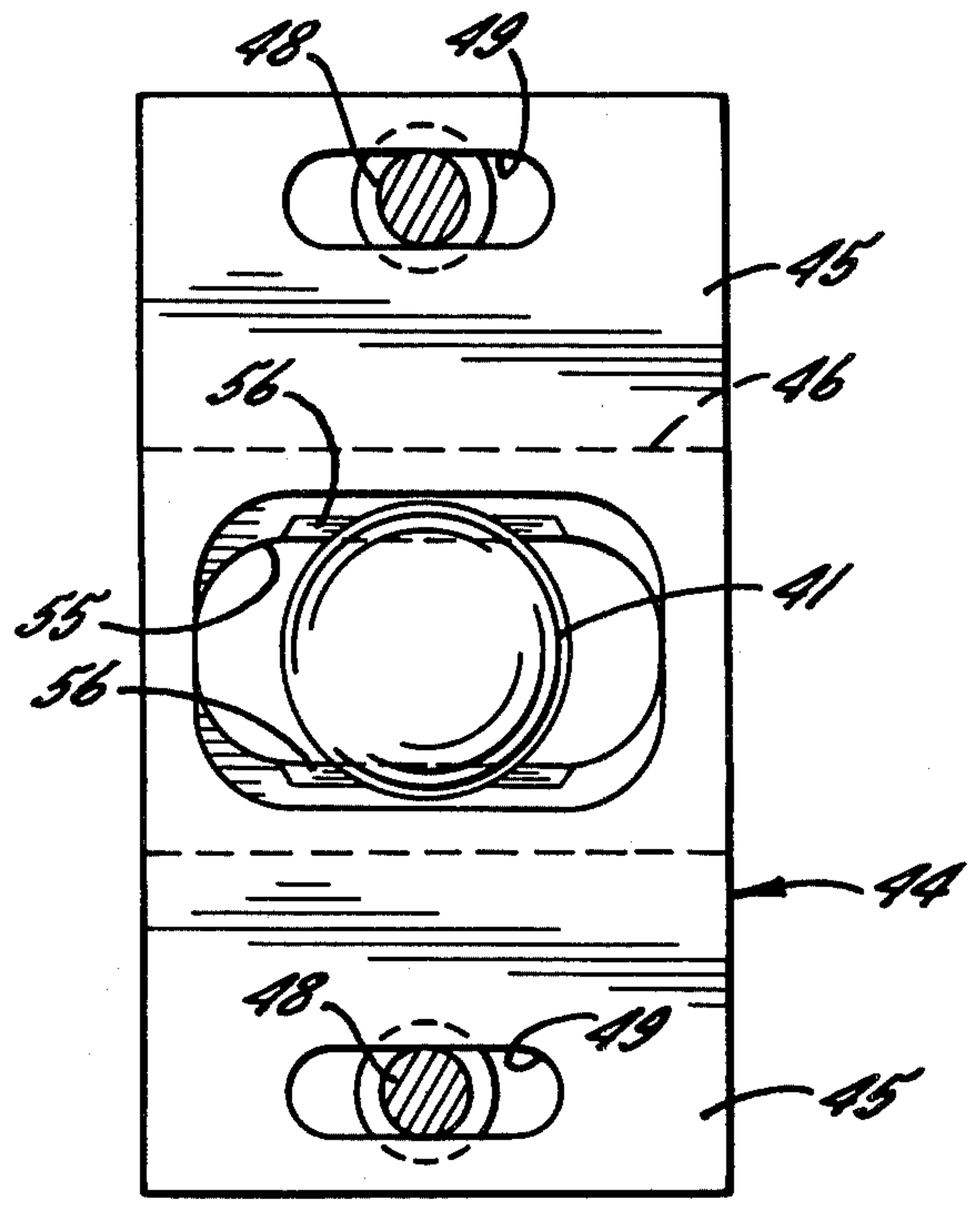

Fig. 4.

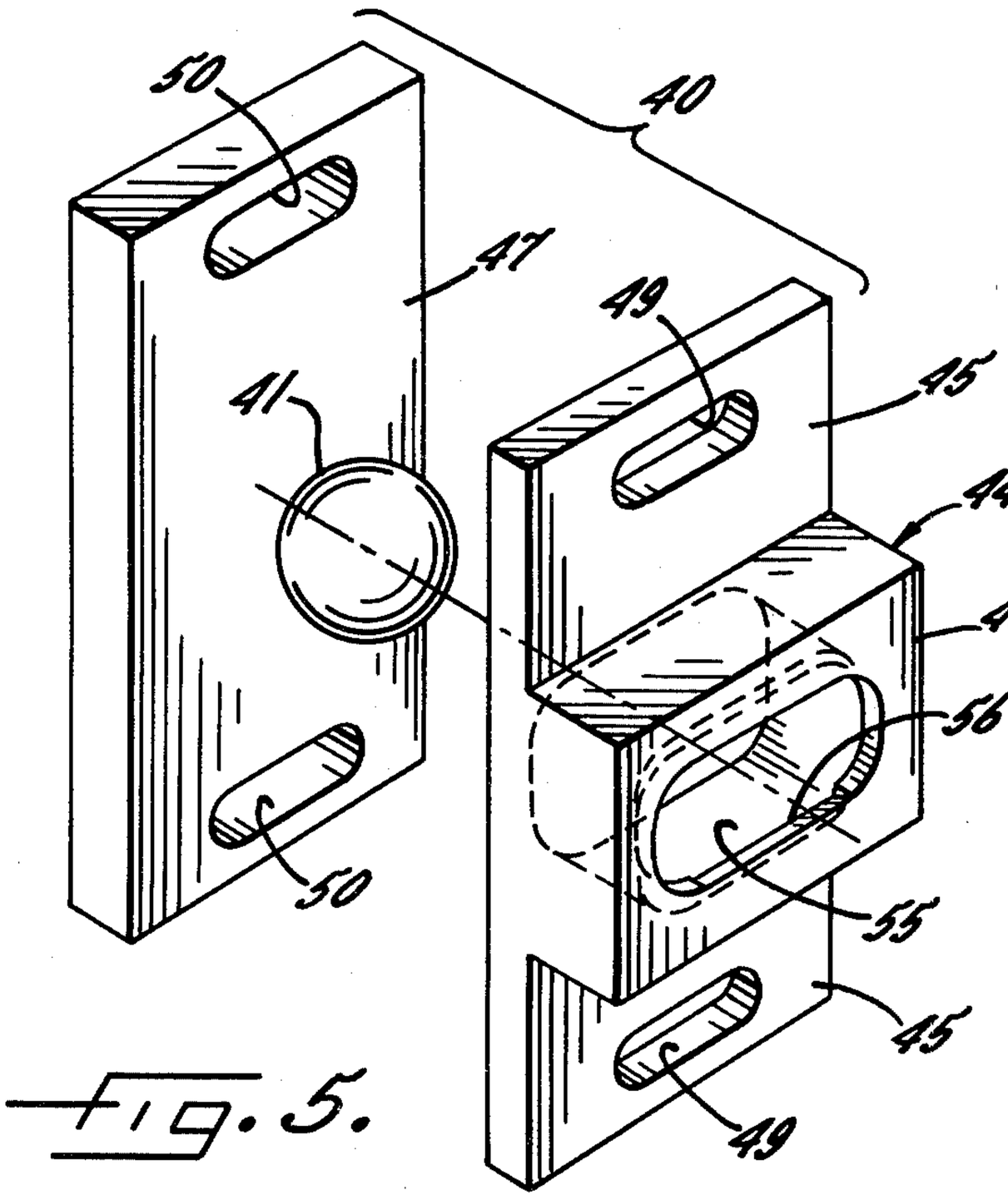

Fig. 5.

APPARATUS FOR CLOSING AND SEALING A DOORWAY

BACKGROUND OF THE INVENTION

This invention relates generally to apparatus for closing and sealing a doorway in a wall. More specifically, the invention relates to apparatus for closing and sealing a doorway which leads to the chamber of a furnace such as a vacuum furnace for brazing aluminum parts. A furnace of this general type is disclosed in Bielefeldt U.S. Pat. No. 3,609,295. During a typical process for brazing aluminum parts in a vacuum furnace, magnesium is vaporized in the furnace chamber in order to promote wetting of the aluminum surfaces and avoid the need for using flux. Moreau U.S. Pat. No. 3,673,678 discloses a fluxless brazing process in which magnesium is vaporized in the furnace chamber.

The apparatus for closing and sealing the doorway of the furnace chamber usually comprises a door which is mounted on the inner side of a door carrier to move with the carrier and also to move relative to the carrier. The carrier and the door are adapted to be shifted back and forth in unison along a path substantially paralleling the plane of the doorway to move the door between open and closed positions relative to the doorway. After the door has been moved to its closed position, it is shifted inwardly relative to the carrier and into tight engagement with the wall of the furnace chamber so as to seal the doorway. The door is shifted outwardly from sealing engagement with the wall prior to being moved to its open position.

Bearing means engage the outer side of the carrier to support the carrier with rolling friction as the carrier moves the door between its open and closed positions. The bearing means also sustain the outward reaction force which is imposed on the carrier when the door is shifted inwardly into sealing engagement with the furnace wall.

In prior door apparatus of the foregoing type, the bearing means have consisted of a ball bearing roller mounted to rotate about a fixed shaft. Rollers of this type experience a very short service life. The bearings become crushed by the outward force exerted by the carrier and, in addition, magnesium which accumulates in the vicinity of the furnace causes the bearings to gall and jam.

SUMMARY OF THE INVENTION

The general aim of the present invention is to provide new and improved door apparatus of the foregoing type and having unique bearing means which are more durable and trouble-free in service use than prior bearing means used for similar purposes.

A related object of the invention is to provide novel bearing means capable of withstanding the outward force of the door carrier without failing and capable of remaining free-rolling in spite of the presence of the magnesium, the bearing means being self-cleaning and preventing magnesium from building up and interfering with the rolling action.

A more detailed object is to achieve the foregoing by providing unique bearing means having a single spherical ball which is supported to spin universally about its own center and, at the same time, to roll back and forth along a defined path as the door carrier moves to open and close the door. Being capable of both spinning and rolling, the ball effectively cleans itself of magnesium which otherwise would cause jamming and galling. In addition, the ball can withstand high thrust loads without being crushed or otherwise damaged.

The invention also resides in the novel and relatively simple construction of a cage for captivating the ball for back and forth rolling while allowing the ball to spin universally about its own center, the cage insuring that the ball will roll back and forth each time the door is opened or closed.

These and other objects and advantages of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a fragmentary cross-section taken horizontally through a furnace equipped with new and improved bearing means incorporating the unique features of the present invention, the view being taken substantially along the line **1—1** of FIG. **2**.

FIG. **2** is a fragmentary cross-section taken substantially along the line **2—2** of FIG. **1**.

FIG. **3** is an enlarged view of one of the bearing means shown in FIG. **2**.

FIG. **4** is a cross-section taken substantially along the line **4—4** of FIG. **3**.

FIG. **5** is an exploded perspective view of the bearing means shown in FIG. **3**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

For purposes of illustration, the door apparatus **10** of the present invention has been shown in the drawings in conjunction with a furnace **11** such as a vacuum furnace for brazing aluminum parts (not shown). In certain aluminum brazing processes, magnesium is vaporized in the furnace and acts as a gettering agent.

The furnace **11** comprises a walled enclosure **12** defining a heating chamber **13** for receiving the parts. Heating elements (not shown) are adapted to heat the chamber to a high temperature while a vacuum pump (not shown) communicates with the chamber to evacuate the air therefrom and establish a vacuum in the chamber. The above-identified Bielefeldt patent contains a detailed disclosure of a typical vacuum brazing furnace.

One wall **14** of the enclosure **12** defines a doorway **15** through which the parts may be loaded into the chamber **13**. The doorway is adapted to be selectively closed and sealed by a door **16**. Herein, the door is supported by a door carrier **17** to move horizontally back and forth in unison with the carrier between open and closed positions relative to the doorway along a path extending substantially parallel to the plane of the doorway. In addition, the door is adapted to be shifted inwardly and outwardly relative to the carrier and into and out of sealing engagement with the wall **14** and sealing relationship with the doorway **15**.

More specifically, the door carrier **17** is guided for back and forth horizontal movement on a main support structure or frame whose various parts have been collectively indicated by the reference numeral **18**. Rollers **19** (FIG. **2**) with V-shaped grooves are journaled on the lower end portion of the carrier to turn about horizontal axes and ride back and forth along V-shaped tracks **20** mounted on the frame **18**. Additional rollers **23** are journaled on the upper end of the carrier **17** to turn

about vertical axes and ride back and forth within channel-like tracks **24** on the frame. To effect back and forth horizontal movement of the carrier, a hydraulic actuator (not shown) is connected to the frame and includes a reciprocating rod **25** which is pivotally connected to the carrier at **26**. When the rod is extended, the carrier **17** first shifts the door **16** horizontally from its open position shown in phantom lines in FIG. **1** to a closed but unsealed position in which the door is alined with but is spaced outwardly from the doorway **15**. Thereafter, the door shifts inwardly relative to the carrier and moves into sealing engagement with the wall **14** as shown in solid lines in FIGS. **1** and **2**.

The door **16** is connected to the door carrier **17** by a set of three vertically spaced front links **30** and by a set of three vertically spaced rear links **31**, only one of the rear links being visible. The inner end of each link is pivotally connected to the door by a vertical pin **32** while the outer end of each link is connected pivotally to the carrier by a vertical pin **33**. Each link may be of the spring-loaded type disclosed in Gaede U.S. Pat. No. 3,558,112. The rollers **23** are located above and are coaxial with the pins **33** of the upper links **30** and **31** of the two sets.

Coaxial with the pins **32** of the upper and lower links **30** of the forward set of links are upper and lower rollers **35** which ride within upper and lower channel-like tracks **36** on the frame **18**. Near their forward ends, the latter tracks are curved inwardly as indicated at **37** in FIG. **1**.

When the rod **25** is extended to shift the carrier **17** forwardly the door **16** moves horizontally from its open position and moves in unison with and parallel to the carrier until the rollers **35** engage the curved positions **37** of the tracks **36**. Such engagement causes the links **30** to pivot about the pins **32** and **33** and cams the door **16** inwardly relative to the carrier **17** and into tight sealing engagement with the wall **14** to enable a vacuum to be established in the chamber **13**. When the rod **25** is retracted, the door moves outwardly from the wall **14** until the rollers **35** engage the straight portions of the tracks **36**. Continued retraction of the rod then causes the door to move with the carrier to its fully open position.

In accordance with the present invention, unique bearing assemblies **40** are located between the frame **18** and the outer side of the carrier **17** to support the carrier with rolling friction and to sustain the outward thrust which is imposed on the carrier when the door **16** shifts inwardly into sealing engagement with the wall **14**. The bearing assemblies are particularly characterized by their ability to sustain heavy thrust loads without failing and by their ability to remain free-rolling in spite of the accumulation of magnesium in the vicinity of the bearing assemblies.

More particularly, six identical bearing assemblies **40** have been shown in the drawings, there being front and rear sets of three vertically spaced assemblies secured to the frame **18** and engageable with the outer side of the front and rear portions of the carrier **17** when the door **16** is in its closed position. Each bearing assembly comprises a spherical steel ball **41** (FIGS. **3** to **5**) having a diameter of approximately 1½ inches and having a hardness of approximately 60 Rockwell C. Each ball is adapted to engage and roll against a hardened wear plate **42** (FIGS. **1** and **2**) which is secured to the outer side of the carrier **17**.

In carrying out the invention, the ball **41** of each bearing assembly **40** is uniquely captivated so as to roll back and forth when the carrier **17** is shifted and, at the same time, to spin universally about its own center. For this purpose, each ball is supported by a cage **44** (FIGS. **3** to **5**) having a pair of mounting flanges **45** and having a retainer box **46**. The ball is housed within the retainer box and engages a back-up plate **47**. Screws **48** extend through elongated slots **49** in the flanges **45** and through elongated slots **50** in the back-up plate **47** and are threaded into the frame **18** to secure the cage and the back-up plate to the frame. The cage is hardened to about 40 Rockwell C while the back-up plate is hardened to about 55 Rockwell C.

As shown in FIGS. **3** to **5**, the retainer box **46** is elongated in the fore-and-aft direction and its inner side is formed with a slot **55**. The slot **55** extends completely through the inner side of the box **46** and also is elongated in a fore-and-aft direction. The major or fore-and-aft dimension of the slot is about 2½" while the minor or vertical dimension of the slot is about 1 3/16". Thus, the ball **41** is capable of rolling back and forth within the slot **55** with a portion of the ball projecting inwardly through the slot as shown in FIG. **3**. The outer sides of the long edges of the slot are chamfered as indicated at **56** in FIG. **4** while the ends of the slot are rounded substantially in accordance with the diameter of the ball. The back-up plate **47** holds the ball against the chamfered edges of the slot.

With the foregoing arrangement, the ball **41** of each bearing assembly **40** rolls back and forth within the slot **55** of its cage **44** when the carrier **17** is shifted to move the door **16** between its open and closed positions. In addition, each ball spins universally about its own center. As a result of such rolling and spinning, the ball tends to clean itself and the cage of magnesium which accumulates in the area of the bearing assembly **40** by virtue of the brazing operation. The ball thus remains free-rolling and does not gall or seize. When the door **16** is shifted inwardly from its closed position to its sealed position, the ball sustains the outward force which is imposed on the carrier **17**. Being hardened and being of relatively large diameter, the ball is capable of withstanding comparatively high forces without crushing or otherwise failing. Accordingly, the bearing assembly **40** is durable and is capable of experiencing a long service life.

Preferably, each bearing assembly is mounted on the frame **18** at a slight angle (e.g., ten degrees) such that the slot **55** slopes upwardly as the slot proceeds from the rear of the furnace **11** toward the front thereof. As a result, the carrier **17** forces the ball **41** to ride upwardly in the slot when the door **18** is shifted to its closed and sealed position and considerable force is exerted on the carrier and the ball. When the door is opened, gravity assists in moving the ball down the slot to insure that the ball returns to a starting position and does not become stuck in a position between the ends of the slot. The elongated slots **49** and **50** permit the bearing assembly to be mounted at a selected angle.

I claim:

1. Door apparatus for selectively closing and sealing a doorway in a wall, said door apparatus comprising a main support, a carrier having inner and outer sides, and a door on the inner side of said carrier, means mounting said carrier for back and forth movement on said support and enabling said carrier to move said door between open and closed positions relative to said door-

way, said carrier and said door shifting back and forth along a path substantially parallel to the plane of the doorway as said carrier moves said door between said open and closed positions, means mounting said door on said carrier and enabling said door to shift inwardly and outwardly relative to said carrier and into and out of sealing engagement with said wall and sealing relationship with said doorway when said door is in said closed position, and bearing means for supporting said carrier with rolling friction as said carrier moves said door between said open and closed positions and for sustaining the outward force imposed on said carrier when said door is shifted inwardly into sealing engagement with said wall, said door apparatus being characterized in that said bearing means comprise a substantially spherical ball engageable with the outer side of said carrier, and means on said support and guding said ball to roll back and forth through a limited distance along a path substantially parallel to the path of said carrier while leaving said ball free to spin universally about is own center.

2. Door apparatus as defined in claim 1 in which said guiding means comprise a cage having an elongated slot formed in one side thereof, a portion of said ball projecting through said slot.

3. Door apparatus as defined in claim 2 in which said slot is elongated in the direction of the path of the ball, said slot having a major dimension greater than the diameter of said ball and having a minor dimension less than the diameter of said ball.

4. Door apparatus as defined in either of claims 2 or 3 further including a hardened back-up plate secured to said support, said ball being captivated between said cage and said back-up plate.

5. Door apparatus as defined in either of claims 2 or 3 in which said cage is inclined such that said slot is substantially horizontal but slopes upwardly as said slot proceeds in the direction ofthe closing movement of said door.

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